Alice Springs, is 2000 feet above the level of the sea. The Finke River is described as the largest and most important in Central Australia; its southern part is now being re-explored by Mr. Lindsay. On the whole it appears that Mr. Winnecke's map and the details accompanying it add considerably to our knowledge of the geography of Central Australia.

THE last census of the Hawaiian Archipelago, as compared with that of 1878, gives some curious results. In these six years the pure natives have decreased from 44,088 to 40,014, while the half-castes have increased from 3420 to 4218. The Chinese immigrants in 1878 numbered only 5916; in 1884 they had increased threefold, their number being 17,931. In every other respect the population increased. The Portuguese labourers number 9377 against 436; immigrants from the United States were 2066 against 1276; British subjects 1282 against 883; Germans 1600 against 272, and so on. The children born in the archipelago of foreign parents increased from 947 in 1878 to 2040 in 1884. On the whole the population was 80,578 in the latter year, against 57,985 in the former, although the natives had diminished about 10 per cent. in the six years. We thus havd passing under our eyes the peaceful extinction of a race by the operation apparently of natural laws. The Hawaiians govern themselves under a sovereign of their own race, and under their native conditions; yet they are rapidly disappearing, simply through the presence of other races, without war or any other of the direct causes to which the decay of native races is generally attributed. The social conditions of the archipelago are an interesting study just now from many points of view.

M. VAN GEÛNS, Chief Engineer and Inspector of Public Works in Java, has lately been on a journey through that and the neighbouring islands, of which he has published an account. He speaks of the various Javan volcanoes, of which much has been heard lately, and says that since the eruption of Krakatão in 1883 the people live in comparative quiet. But this calm is only apparent, for volcanic eruptions, always numerous, are incessant. The volcanoes on the Island of Java itself manifest everywhere great activity, but not so as to produce a serious cataclysm. Smeroc, which is the highest mountain in the island, and its neighbours Brômo and Lamonyon, are active from time to time. In 1885, for example, Smeroc overwhelmed plantations and villages on its side with eruptive matter. Merapi, in the centre of the island, shows constant signs of life; lava is constantly flowing from it, smoke and steam are almost always visible at its summit, so that it is one of the active volcanes of the world. M. van Geûns reports another curious phenomenon. After a period of extreme drought continued rains have inundated one part of the country, while there is an absolute want of water in other places which should have it in abundance. This anomaly is attributed to the monsoons which blow irregularly, and which cause more anxiety to the Javanese than their volcanoes.

THE MINES COMMISSION REPORT

THE final report of the Accidents in Mines Commission has been issued as a Blue Book. The report, which occupies 120 pages, is accompanied by minutes of the evidence taken and numerous appendixes and diagrams. The report concludes with the following paragraphs, in which the Commissioners give a summary of the most important subjects dealt with and of the chief conclusions and recommendations based upon them:—

Volumes of air sufficient for the ventilation of even the most extensive collieries are capable of being passed through the workings by means of properly constructed furnaces, or by mechanical contrivances, such as are already in action at most of the collieries. At a large number of collieries the sectional area of the intake and return-air courses may be increased with advantage. Where furnaces are used they should by preference be in connection with dry and deep shafts, and should be provided with dumb drifts. Where mechanical contrivances are employed they should be in such positions and placed under such conditions as will tend to insure their being uninjured by an explosion, and, if they are not provided altogether in duplicate, there should be at least an engine in reserve. The improved system of ventilation by "splits" and the shortening of the air-courses, as practised in the larger collieries, is a subject of great importance, and we recommend that more general attention should be given to it. It would conduce greatly to safety if the system of carrying the intake air through two parallel drifts, of which one may be used as the travelling road, were introduced into workings likely to become extensive, and where mechanical haulage is intended to be employed.

That the casualties due to falls of the roof and sides are much more numerous than those due to any other causes is demonstrated by the tabular statement given at the commencement of this report. It is essential that all the officials and workmen in mines should pay special attention to the careful propping of the working places and travelling roads. In the north of England the system of trusting mainly to officials (deputies) for the timbering is found to answer well; in South Wales and other districts, where the roof, face, and sides are more liable to falls, the system of the men timbering their own working places has been found to be best.

We are of opinion, however, that in all cases the security of the working places should be examined into by over-lookers once at least in the course of each shift. Supervision has been greatly enlarged in the last thirty-five years, and we find that there is generally one official so employed to about twenty men, sometimes one even to eleven or twelve men. In order to reduce the number of casualties from falls, we recommend the observance of the following:—(*a*) The maintenance of ample supplies of timber in localities convenient to the workmen; (*b*) the proper training of each miner to the best modes of timbering and of otherwise protecting his working place; (*c*) the exercise of increased care on the part of the workmen in watching the roof, sides, and face, and protecting themselves in time; (*d*) the introduction, as far as possible, of arrangements with the workmen which will make it their interest not to avoid the labour of putting up the necessary timber, cog-walls, buildings, or nogs for their proper protection; (*e*) the employment of special timbermen or deputies for the timbering of main ways and also for the repairing as well as drawing of timber; (*f*) preventing timber being left in the goaf of long wall workings, which would have the effect of breaking the roof; (*g*) driving the working places as rapidly as possible by shifts of an ample number of workmen in each face, and so reducing the risk of falls and exposing the least number of men to danger at any one time.

We are of opinion that by improved discipline and the exercise of greater care by those employed in or travelling through engine planes and other roadways the number of casualties comprised under the head of "miscellaneous accidents" would be considerably diminished. The practice in some collieries in South Wales of boys running in front of the horses and trams should be prohibited. The very numerous casualties under the heads of "falls of roof and sides" and "miscellaneous accidents" are due in great part either to carelessness or want of early training. Looking to the importance of practical training, and of encouraging boys to enter the mines at the ages specified by the Mines Regulation Acts, we are of opinion that careful consideration should be given to this point in connection with the administration of the Elementary Education Act.

We think that the experiments we have made on the pressure of fire-damp in plugged bore holes in coal, a pressure sometimes amounting to upwards of 400 lbs. on the square-inch, have thrown much light upon the occurrence of sudden outbursts of gas. The boring of holes upward or downward has been successfully tried as a means of avoiding such outbursts, and we have little doubt that the closer attention which is now paid to thorough stowing and packing or building in the workings will contribute greatly to the same end. It is almost impossible to account for many of the accidents which have occurred in well-managed mines, some of which have originated in the main-intake airways, except upon the supposition that gas has suddenly invaded the workings from the adjacent strata. Sudden outbursts of large quantities of gas, accompanied by violent disruption of the floor, roof, or coal, are fortunately rare, but smaller incursions of gas, accompanied by falls of roof, or even without any apparent displacement of ground, are comparatively frequent. We are of opinion that in working fiery seams at great depth such abnormal discharges of gas must occasionally occur, yet that they may be successfully met by ample ventilation, good discipline, and efficient lamps. While we recognise that variations of atmospheric pressure exert an influence on the escape of gases which have accumulated in cavities, and possibly to a slight extent on that of gases emitted directly from the coal, we entertain great doubt as to the wisdom of placing reliance on the issue of meteorological warnings. These can at best only convey very imperfect information, which, moreover, may be sometimes dangerously misleading. We are of opinion that safety would be much more likely to be insured by unceasing vigilance on the part of the officials and workmen in the mine than by any attention to such warnings.

The action and effects of coal-dust in connection with mine explosions have been made the subject of careful study and comprehensive experiment by numerous workers since attention was first drawn, about forty-two years ago, by Faraday and Lyell to the functions exercised by coal-dust in "aggravating and extending the injurious effects of fire-damp explosions." The results and conclusions which have been arrived at in this direction, and to which the labours of your Commissioners have contributed, are sufficiently complete and definite to warrant the following authoritative statements:—The disastrous effects of fire-damp explosions in coal-mines are almost always aggravated and extended by the existence of coal-dust in dry mine-workings and roadways. A gas explosion in a dry mine, even if only of comparatively trifling nature, will raise and inflame coal-dust existing at the seat of the explosion or in the vicinity; the flame attending the explosion will be thereby increased and carried to more or less considerable distances, and may thus become communicated to any accumulations of explosive gas-mixture which may exist in goaves or other lurking places at a distance from the seat of the original gas explosion.

The firing of an explosive in shot-hole of a strength which is in excess of the power applied, or which has not been sufficiently tamped, will result in the almost complete projection of the highly-heated products of explosion and of a more or less considerable body of flame from the mouth of the hole, as from the bore of a gun; it thus produces what is known as a blown-out shot. And further, if the charge of explosive is decidedly greater than that necessary to perform the desired work in the coal or stone where it is applied, a more or less considerable projection of highly-heated products of explosion will also take place, and effects similar to those of a blown-out shot will be produced. The production of a blown-out powder shot in a mine-working, in the entire absence of coal-dust, or in a wet mine, is not attended by the projection of flame to a very considerable distance, but the flame thus projected is much increased in volume if, as is frequently the practice, dry or slightly damp small coal has been used as stemming for the shot. If a blown-out powder-shot be produced in a dry locality where coal-dust exists in more or less abundance, the flame projected by the shot is sure to be considerably increased and extended by the ignition of portions of the dust-cloud which is raised by the rush of air occasioned by the firing of the shot. A result of this nature will be produced even if the air in the vicinity of the blown-out shot is entirely free from fire-damp. Unless the coal-dust which exists in the immediate vicinity of a blown-out powder-shot is dry, very finely-divided, and of a very highly inflammable character, the propagation of flame from the shot by the raised dust will only take place to a comparatively limited extent if the atmosphere in which the dust is raised be entirely free from fire-damp. It is, however, well established that, even when the air is quite free from fire-damp, an exceptionally inflammable coal-dust, in a very finely divided and dry condition and existing in abundance in the immediate vicinity of a blown-out shot, may, when raised by the shot, be ignited so readily, and carry on the flame so rapidly, that it may produce explosive effects of a similar character to those caused by a gas explosion. The flame, as it rushes along, if fed by freshly raised dust, may extend under these circumstances to very considerable distances, with results resembling, in their disastrous nature, those of explosions originating with, and mainly due to, fire-damp. If a blown-out powder-shot occurs in a locality where the atmosphere contains a small proportion of fire-damp (even not above two parts in 100 of the air), the presence of dry, fine, and porous dust, even if it be only comparatively slightly inflammable, may give rise to the explosive propagation of flame to distant localities, where either accumulations of inflammable or explosive gas-mixture (as in goaves or old working places), or deposits of very inflammable dust, may take up the explosion and still further extend its disastrous effects. Wherever a coal is worked which contains inflammable gas, the atmosphere in the vicinity of the workings, however efficient the ventilating arrangements, will at one time or another, and, it may even be said, generally, contain some small proportion of fire-damp. Mines have hitherto been considered free from fire-damp when the search for gas by means of a lamp flame has been unattended by the appearance of a cap upon the flame or by an elongation of the flame. This test, however, fails to indicate the presence of fire-damp, if the atmosphere contains less than from 2 to 2·5 per cent. of its volume of marsh gas. Such a slight contamination of the atmosphere by fire-damp is not only sufficient to greatly enhance the dangers due to the existence of dust in any abundance in a dry mine-working, as already described, but is also sufficient actually to give rise to the production of an explosive mixture with dust raised in it by a blown-out shot. Small proportions of gas, such as are referred to, when existing in the atmosphere of a mine, can now be detected by more delicate gas-indicators than a lamp flame; but, while a knowledge is thus afforded of the presence of gas, it remains impracticable to prevent such slight contamination by fire-damp of the air of a mine near the working places.

It will be seen from the foregoing that such contamination, although quite insufficient to constitute in itself a source of danger, does become dangerous if dust co-exists with it, in abundance, in dry mine-workings, if powder-shots are fired in such workings. No means are at present known by which security can be attained against blown-out shots during blasting in hard coal or in stone, and the use of powder in coal is sometimes attended by the emission of flame, even when blown-out shots are not produced. It follows from the foregoing that the firing of powder-shots in a dry mine-working where dust exists in abundance must always be liable to be attended with disastrous results if the air in such a locality is contaminated by fire-damp, even to so small an extent as in the proportion of two volumes in 100 volumes of the air of the mine. The constant removal of accumulating dust from the workings in dry mines, to such an extent as to guard against the raising of any considerable quantity of dust where shots are fired, could scarcely be so thoroughly carried out, in any but very exceptional cases, as to constitute by itself an effectual precaution. The application of water to the laying of dust in roadways has been applied here and there with some amount of success, but the effective adoption of such a measure in or near the working places is in some instances attended with practical difficulties. Unless very copious watering be resorted to, it would be ineffectual in guarding against the dangers arising from the firing of powder-shots in dry and dusty workings where the air may contain some small proportion of fire-damp. The employment of hygroscopic or deliquescent salts in conjunction with water has not been found a trustworthy means of maintaining dust in a safely moist condition. The dangers which attend the firing of powder-shots in dry mine workings where dust exists in abundance, and where the air may contain even only a small proportion of fire-damp, can therefore not, with our existing knowledge, be effectually guarded against, except by combining the removal of dust as far as practicable with very copious watering. The obvious inference to be drawn from the foregoing is that a due regard for the safety of those employed in mines, where the conditions above indicated prevail, precludes the use of powder, unless the precautions just specified are effectually applied. The results of extensive practical experiments, carried out by ourselves and by others, have demonstrated that the abolition of the use of powder, where the conditions above indicated prevail, will not generally involve any formidable inconvenience, because the work which is accomplished by its employment, both in coal and in stone, can now be performed with equal efficiency and at very little, if any, greater outlay, by one or other of the following available alternative means:—(*a*) In some coal-seams the lime-cartridge will perform work quite equal to that accomplished with powder, at no greater cost, and with absolute immunity from risk of explosions; (*b*) mechanical appliances exist which will do efficient work, not only in some kinds of coal, but also in some stone or shale over or underlying coal; (*c*) the so-called "high" or violent explosive agents, which are represented by dynamite or gelatine-dynamite, and by gun-cotton or tonite, can now be applied, not only for working economically in stone or shale, but also for coal-getting, by using them in conjunction with water, according to one or other of the methods described in this report.

The "high" explosives may be used, as indicated in (*c*), with security against the ignition of coal-dust thickly suspended in air, by a blown-out shot or by the effects of an over-charged hole, even when the air contains some small proportion of fire-damp. One very simple method of using the "high" explosives in conjunction with water, included in (*c*), which may be supplemented by the use of ordinary tamping for securing the best working results, has, so far as several severe tests have shown, afforded a complete safeguard even against the ignition of an explosive mixture of fire-damp and air by a blown-out shot.

Therefore, in dry mine-workings, where the removal of dust, combined with copious watering cannot be carried out, and where neither of the alternative methods (*a*) and (*b*) of working in coal or stone can be advantageously substituted for blasting by means of powder, in localities where fire-damp is liable to have access to the mine-workings, shot-firing may be safely carried on, provided that any one of the "high" or violent explosives is employed, in one or other of the modes described, in substitution for powder. But the methods of operation which furnish effective safeguards when applied in conjunction with the high explosives fail to furnish such safeguard when applied in the same way together with powder. Unless, therefore, effective measures be adopted for the removal of dust as completely as practicable in the vicinity of the place where the shot is to be fired, such removal being followed by copious watering, the employment of powder, or of any explosive preparation of a similar nature to powder, should be prohibited in dry coal-mines where fire-damp may pervade the air, and where at the same time coal-dust accumulations are unavoidable.

With the view of promoting security from accidents under circumstances where blasting may be practised in coal-mines we would recommend that the following instructions be observed:—(1) That all work involving blasting in mines should be intrusted only to experienced workmen. (2) That, in order to lessen the risk from blown-out shots, particular care should be taken that each shot should be assisted by under-cutting and nicking or shearing whenever it is practicable. (3) That the tamping, stemming, or ramming should consist of very damp or non-inflammable material. (4) That where strong tamping is needed the compression of air at the bottom of the hole should be avoided by pushing in the first part of the tamping in small portions. (5) That where safety-lamps are used and powder is employed the shots should be fired only by specially-appointed shot-men, who before firing the shots shall satisfy themselves that the foregoing instructions are observed, and shall also satisfy themselves by carefully examining all accessible contiguous places within a radius of twenty yards of the shots to be fired that fire-damp does not exist to a dangerous extent.

The employment of the ordinary miner's fuse, which when burning is liable to allow fire to escape from its extremity or laterally into the atmosphere, should not be permitted in any mine-workings where the exigencies of safety dictate the exclusion of powder and the substitution for it of one or other of the "high" explosives in conjunction with water. Similarly, no description of mining fuse, however safe in itself, should be allowed to be ignited in such localities by means either of a lamp-flame or of a wire which has been made red hot by inserting it into the gauze of a safety-lamp, or by means of any other source of fire, which, when applied to the lighting of the fuse, must come into contact with the atmosphere of the mine. Electrical exploding appliances present very important advantages from the point of view of safety over any kind of fuse which has to be ignited by the application of flame to its exposed extremity, as the firing of shots by their means is not only accomplished out of contact with air, but is also under most complete control up to the moment of firing. Their simplicity and certainty of action have been much increased of late years while their cost has been greatly reduced, and but little instruction is now needed to insure their efficient employment by persons of average intelligence. For the foregoing reasons the use of electrical arrangements for firing shots in mines, where the employment of powder for blasting is inadmissible, should be encouraged as much as possible. Where the regular use of electrical exploding appliances is attended with serious difficulties, as in wet mines, a special form of miner's fuse, now procurable at a cost very slightly, if at all, greater than that of the ordinary miner's fuse, and exempt from the defect of a possible lateral escape of fire, should be employed, but it should be used only in conjunction with a special self-contained igniting arrangement. Such an appliance should be constructed to fit over the entire exposed end of the fuse in a shot-hole, and to ignite the fuse out of contact with the air, and after the lapse of a definite interval (*i.e.* five minutes) from the time when it has been set into action by the person in charge of the shot-firing. Simple, cheap, and efficient forms of "igniter" have been devised which fulfil these conditions.

It has been shown that mines which have hitherto been considered free from fire-damp may have the air which passes through them vitiated to an extent corresponding to about 2 per cent. of its volume of marsh gas. The air in many such mines may probably never be entirely free from explosive gas, at all events in the neighbourhood of freshly cut faces of coal and in the return airways. It has been demonstrated in our experiments that when the atmosphere contains 5 to 5·5 per cent. of marsh gas it becomes highly explosive. We have even obtained explosions which, though less violent, might be nevertheless destructive of life if they occurred on the large scale possible in a mine when the air contained only 4 per cent. of marsh gas. It will thus be seen that air which would appear free from gas if tested in the ordinary way may become by the addition of only about 2 per cent. of marsh gas capable of propagating flame and causing destruction, while the addition of about 3 per cent. converts it into a highly explosive mixture. As we have already pointed out, air which would appear quite free from gas if examined by a lamp flame may become explosive when laden with fine, dry coal-dust. It has been stated that appliances now exist by which very small proportions of marsh gas in air may be readily detected, and which can be used for examining the atmosphere of a mine. With Liveing's indicator present, gas in the air can be estimated with sufficient accuracy for all practical purposes, even when the proportion is as low as 0·25 per cent. Maurice's indicator is also capable of giving accurate measures of the proportion of gas, and is very portable, but the time required in taking an observation with the instrument in its present form seems to preclude its practical application.

The natural inference from the foregoing is that some mines hitherto considered safe with naked lights may at times be in peril. It may be that risks of explosion, arising out of the possibility of an unforeseen contamination of the air by fire-damp to a dangerous extent in parts of the workings of some coal-mines, can only be provided against by the invariable use of safety-lamps. We have not, however, considered it advisable to make a suggestion of this nature, because the great preponderance of casualties due to falls of stone and coal, over those arising from explosions, points to the importance of miners having the advantage of superior illumination afforded by naked lights in comparison with even the best forms of safety-lamp, when the circumstances of the mine, in regard to association of fire-damp and coal-dust, do not necessitate the use of safety-lamps.

We have therefore arrived at the following conclusions:—(1) That it is most important that all mines should be carefully examined by means of indicators capable of detecting as small a proportion as 1 per cent. of gas; such examination to be made before the commencement of each day-shift, and, in case of an interval, also before the succeeding shift. (2) That in all dry mines where the air may be laden with coal-dust, and where fire-damp is either known to be given off from the strata, or may from experience be reasonably suspected to exist, the Secretary of State may require safety-lamps to be used, unless the owners and workmen of such mines prove, to the satisfaction of a court of arbitration to be appointed by the respective parties, that less liability to accidents, generally, will be involved by the working of the mine with open lights than by the use of safety-lamps. It should be a special instruction to such court that the circumstances of each mine be taken into consideration with reference to the following points: (*a*), the mode of working; (*b*), the nature of the coal-seams and of the roofs and floors of the seams and of the adjacent strata; (*c*), the proximity of the seams to each other; (*d*), the emission of gas from the seam, and the liability to blowers or outbursts of gas from the coal, roof, or floor; (*e*), the order of working the seams of coal. For the system which prevails in some places of working with mixed lights—that is, with open lights and safety-lamps intermixed in the same set of workings—there is no justification, and this practice should be strictly prohibited. We are of opinion that in mines where safety-lamps are required, the position of lamp stations, or places where open lights are allowed, in reference to the possibility of access of vitiated air, should receive much more attention than at present. It is desirable that, at convenient places near the working faces, reserves of lighted and locked lamps be kept available for exchange with those extinguished in the workings.

It has long been known that if the atmosphere become inflammable the Davy and Clanny lamps, and in a less degree the Stephenson lamp, are unsafe in currents having velocities much below those encountered in well ventilated mines. Our experiments fully confirm this. The ordinary Davy lamp becomes unsafe before a velocity of 400 ft. per minute is attained. The ordinary Clanny lamp will almost certainly cause an explosion in a current having a velocity of 600 ft. per minute. A Stephenson lamp will frequently cause an explosion in a current with a velocity of 800 ft. per minute. From the information supplied to us by your Majesty's Inspectors of Mines and others, currents having velocities of more than 400 ft. per minute are now frequently found in working places. The currents sweeping long wall-faces have very often higher velocities, in main airways current-velocities approaching 2,000 ft. per minute are recorded, and considerably higher velocities are encountered at regulators and in narrow places, or when large falls occur. It is thus obvious that, in the present improved ventilation of collieries, ordinary Davy and Clanny lamps have ceased to afford protection from explosion, and that the Stephenson lamp, though more secure than the two former, cannot be relied upon. We felt it our duty at an early stage of our investigation to draw the attention of the Secretary of State to the danger attending the use of the ordinary Davy and Clanny lamps, and our subsequent experiments have made this danger still more conspicuous. We have no hesitation in stating that these lamps should be prohibited, unless they are inclosed in cases capable of effectually preventing the gauze from being exposed to the full force of the current of air. Many lamps now exist which are able to resist, in highly explosive atmospheres, current velocities up to and even exceeding 3000 ft. per minute, at all events for several minutes. Ample time is thus obtained for bringing into operation a "shut off" appliance for the extinction of flame produced both by the illuminant and by ignited gas within the lamp. We consider that all safety-lamps should be provided with such an appliance.

Four lamps seem to us deserving of special attention, as combining a high degree of security with fair illuminating power and simplicity of construction. They are Gray's lamp, Marsaut's lamp, the bonneted Mueseler lamp, and Evan Thomas's modification of the bonneted Clanny lamp, described as No. 7 in our report. In our experiments the last lamp has given upon the whole the best results. It will be seen, however, from our experiments that many other lamps exist which are simple in construction, and almost, if not quite, as safe as the above. They generally, however, yield an inferior light in consequence of the flame being surrounded by gauze, but from this method of construction they derive the advantage of not being entirely dependent on glass for their security. To make a particular lamp compulsory would be unwise, as calculated to throw difficulties in the way of introducing improvements which will no doubt arise in the future, but we think it desirable that some control should be exercised in reference to the description of lamps employed in coal-mines, and that only those lamps should be used which are authorised from time to time by the Secretary of State. A lamp may be of the safest pattern and yet small defects in the fitting of its parts may entirely deprive it of its power of affording protection. In preparing a large number of lamps for use in a mine it may happen, even with the greatest care on the part of the lamp-men, that a lamp in an imperfect condition may be allowed to pass. The detection of these imperfections by simple inspection is in many cases almost impossible, and we are convinced that the only way of avoiding the introduction into a mine of a dangerously imperfect lamp is to test every lamp in an explosive mixture of air and some inflammable gas before it is allowed to descend the shaft. Though we have good reason to believe that the practice of surreptitiously opening safety-lamps in the workings is much less prevalent than formerly, it is still necessary that such lamps should be locked. We have examined many appliances for this purpose, and we consider that the plan of fastening the oil vessel to the other part of the lamp by a riveted lead plug, impressed at each end with marks or letters varied from time to time, is the simplest, the most efficient, and the one most likely to lead to the detection of any attempt to tamper with the lock. The power and uniformity of illumination given by a lamp can be notably improved by using, as the illuminant, vegetable or animal oil mixed with about one-half of its volume of a petroleum oil of safe flashing-point. The use of petroleum spirit or benzine as the illuminant in safety-lamps instead of vegetable or animal oil, is attended with some advantages, but it is also liable to introduce new sources of danger. Special care is needed in the filling and trimming of lamps, and in the arrangement of lamp rooms, to avoid the ignition of the highly explosive mixture formed by air with the vapour arising from this spirit. The selling of petroleum spirit, or of spirit of similar character as to volatility, under designations which are calculated to mislead in regard to the nature of the illuminant, is a proceeding fraught with danger, unless all vessels containing such illuminants bear a prominent label indicating the dangerous nature of their contents. Stringent regulations as to the conditions under which illuminants of this class are to be used and stored are absolutely necessary.

The advantages in point of convenience and efficiency which attend the employment of electric glow-lamps for illuminating the pit's bottom and roadways immediately adjacent to it have already been demonstrated at several collieries where this utilisation of the electric light has been combined with illumination at the surface by arc lights. In applying electric glow-lamps to underground illumination, to the extent indicated, through the medium of conducting cables leading from the generators to the pit bottom, it is essential to safety, as well as to the permanent efficiency of the installation, that the cables should be placed in positions where they are thoroughly protected against possible accidental injury. It is also essential, in all mines where fire-damp has been known to occur, that the glow-lamps should be excluded from direct contact with the air of the mine in one or other of the ways indicated in this report. Portable, self-contained electric lamps have been devised which will furnish for several successive hours a light considerably superior to that of the best safety-lamps, and which at the expiration of eight hours and upwards will still give a light fully equal to that of a freshly lighted Davy lamp. These lamps are perfectly safe, but as they do not afford any indication of the condition of the atmosphere in a mine, their employment, even if special fire-damp detectors are used, cannot in any case entirely dispense with the necessity for the use of some safety-lamps. For exploring purposes after accidents, or in foul places, these lamps must prove very valuable even in the present condition of their development, and as auxiliary lights they cannot fail to prove very useful. The great progress which has recently been made in the construction of portable electric lamps affords promise of a speedy utilisation of such lamps to an important extent in coal-mines.

While we think that the safety-hooks at present available may have contributed to prevent fatalities from over-winding, we believe that the best appliance for the purpose is an automatic steam brake attached to the winding-gear, and we think it desirable that such brake should be introduced where practicable.

We consider that measures should be adopted to deal more systematically, and if possible more expeditiously, with casualties resulting from the various sources of accidents dealt with in this report. Collieries or mines should be required to provide an ambulance and stretchers for the purpose of conveying to their homes sufferers from injuries received while in the discharge of their duties. Arrangements should be made for the establishment of centres in mining districts, where additional appliances for succour and relief, and also special appliances for exploring purposes, should be maintained in an efficient condition, so as to be ready for use at the shortest notice. It is most desirable that facilities should be afforded for the instruction of men in the use of special auxiliary appliances for exploring purposes, and in simple measures connected with the provisional treatment of injuries. We attach great importance to the systematic inspection of each mine by the workmen, as provided for in General Rule 30 of the Coal Mines Regulation Act, 1872, and we recommend that this provision should be generally and regularly acted upon.

Concluding Observations

In submitting to your Majesty the results of our inquiries and experimental work, and the conclusions to which they have led us, we desire to express our regret at the unavoidable delay which has occurred in the presentation of our report. This delay has been due to the wide range of important and very extensive subjects included in the reference to us, and to the great difficulties we have experienced in bringing to a close the experimental work upon which we have been engaged, almost continuously, since we first entered upon the inquiry intrusted to us. These difficulties have arisen in part out of the constant succession of inventions and suggestions submitted to us in connection with the questions under investigation, many of which demanded careful consideration and necessitated the institution of fresh experiments. They have also been in part due to the circumstance that, as our investigations progressed, the results obtained opened up new fields into which it was necessary to extend our inquiries. In bringing our labours to a termination, we feel very strongly that many of the subjects with which we have dealt need much further elucidation by perseverance in experimental research of the kind which we have pursued. We are convinced that if the work which we are relinquishing were continued, the knowledge of the conditions to be fulfilled for securing safety from preventable disasters, and the development of resources and appliances calculated to promote the fulfilment of those conditions, could still be much advanced. It is moreover certain that new subjects for inquiry connected with the safe working of coal-mines must continue to present themselves, as has been the case during our seven years' experience. These considerations have impressed upon us the need for the official establishment of some permanent arrangement by which the continuous pursuit of this highly important class of work would be secured, and by which, also, the merits of suggestions and inventions presenting themselves from time to time would be investigated properly and thoroughly, and dealt with authoritatively. We consider, moreover, that the complete investigation of coal-mine disasters would be greatly promoted if the arrangements to which we have referred were utilised systematically, in connection with the usual official inquiries, in dealing with the difficulties which frequently arise in elucidating the causes of these disasters.

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CRAWFORD AND BALCARRES.
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March 15, 1886

SCIENTIFIC SERIALS

IN the *Journal of Botany* for March Mr. G. A. Holt describes and figures a species of moss, *Thamnium angustifolium*, not only new to Britain, but new to science. It was found sparingly in Derbyshire.—Mr. J. G. Baker concludes his comparison of the British and Continental forms of the difficult genus *Rubus*.

Proceedings of the Linnean Society of New South Wales, vol. x. part 3, Sydney, December 21, 1885.—This part contains the proceedings of this most energetic Society for July, August, and September, 1885, and memoirs by the following:—Dr. R. von Lendenfeld, monograph of the Australian sponges, part 5 (plates 26-35). The Auleninæ, order 3, the Ceraospongiæ, Halme, Aphrodite, Aulena, and Halmopses are established as new genera. part 6 (plates 36-38), on the genus Euspongia.—On a sponge destructive to oyster culture in the Clarence River, a new species of Chalinulæ.—Addendum to the Australian sponges.—Addendum to the Australian Hydromedusæ.—Note on the Glacial period in Australia.—W. A. Haswell, M.A., jottings from the Biological Laboratory of the Sydney University, on an Australian species of Bonellia; on a greater respiration in fresh-water turtles. From observations on the Australian *Chelodina longicollis*, thinks the phenomena described by S. H. Gage as auxiliary respiration extremely improbable and that the Chelonian can bear with impunity being deprived of oxygen for lengthened periods; but the facts recorded by Simon and Susanne Gage in the March 1886 number of the *American Naturalist* cannot thus be interpreted.—Capt. Hutton, on the supposed Glacial period in Australia.—N. de Miklouho-Maclay, plants used by the natives of the Macleay Coast, named by Baron Müller.—George Masters, catalogue of the hitherto-described Coleoptera of Australia, part 1, Cicindelidæ and Carabidos (960 species enumerated).—J. Douglas-Ogilby, three new fishes from Port Jackson; notes on the distribution of some Australian sharks and rays.—A. Sidney Olliff, new species of Australian Coleoptera belonging to the genera Lacordairia, Xanthophæa, Plagioteium, Catosiopus, and Rhysodes.—W. Macleay, on a new genus (Phalacrognathus) of the sub family Lamprimides.—Rev. Dr. Wools, on double flowers.—K. H. Bennett, remarks on the decay of certain species of Eucalyptus. The species were almost without exception *E. melliodora* and *E. rostrata*, and the cause is ascribed to the enormous increase in the numbers of the opossums. Some idea of the number of this animal in a portion of Gipps' Land may be had from the fact that four men in a short time procured a quarter of a million of skins.

Rivista Scientifico-Industriale, February 28.—Description of a new telescope, the "plesiotelescope," by Prof. Nicodemo Jadanza. This is an astronomical instrument intended for the study of near and distant objects. It is constructed with an achromatic objective, M, to the second focus of which is attached a second lens, N, at a less focal distance than that of the lens M. These two lenses form a compound objective, which brings into view objects at short and great distances.—A new application of electrolysis, by G. F. The anonymous author describes a process for producing damascened work rapidly and economically by electrolysis.—Note on the explosion of boilers in steam-engines, by Prof. Giovanni Luvini. The author traces the bursting of boilers to their chief causes, suggests a practical remedy, and offers some remarks on a means of generating steam with a saving of fuel.—A description of Prof. E. Lommel's aërostatic scales for determining the specific weight of gases, by G. Faè.

Bulletin de l'Académie Royale de Belgique, January.—Description of some crystals of calcite, by Prof. C. Casaro. The author describes a first series of Belgian calcites, comprising the crystals found along the left bank of the Meuse and in some other localities. These are reduced to thirty-two simple forms, of which three are new.—On the difference of sea-level in winter and summer, by Gen. Commines de Marsilly. It is argued that the Polar seas must be higher in summer than in winter, when the accumulation of ice increases the salinity, consequently also the density, of the water.—Note on the display of meteors observed throughout Belgium on November 27, 1885, by F. Folie. The maximum of intensity was generally about 6 p.m., when as many as 155 meteors were observed in a single minute at Louvain.—A contribution to the study of the germ-cell in the lower animal organisms, by C. Van Bambeke.—On the coefficient of internal friction of fluids: determination of its variations according to temperature. Theoretical considerations suggested by the observation of these variations, by P. de Heen.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, March 11.—"On Systems of Circles and Spheres." By R. Lachlan, B.A., Fellow of Trinity College, Cambridge. Communicated by Prof. A. Cayley, F.R.S.

This memoir is an attempt to develop the ideas contained in two papers to be found in the volume of "Clifford's Mathematical Papers" (Macmillan, 1882), viz. "On Power Co-ordinates" (pp. 546-55), and "On the Powers of Spheres" (pp. 332-36). The conception of the "*power* of two circles," or spheres, as an extension of Steiner's use of the "*power* of a point with respect to a circle," is due to Darboux.

The memoir is divided into three parts: Part I. consists of the discussion of systems of circles in one plane; Part II. of systems of circles on the surface of a sphere; and Part III. of systems of spheres.

The power of two circles is defined to be the square of the distance between their centres less the sum of the squares of their radii.

Denoting the power of the circles (1, 2) by $\pi_{1,2}$ it is proved that the powers of any five circles (1, 2, 3, 4, 5) with respect to any other circles (6, 7, 8, 9, 10) are connected by the relation—

$$\begin{vmatrix} \pi_{1,6} & \pi_{1,7} & \pi_{1,8} & \pi_{1,9} & \pi_{1,10} \\ \pi_{2,6} & \pi_{2,7} & \pi_{2,8} & \pi_{2,9} & \pi_{2,10} \\ \pi_{3,6} & \pi_{3,7} & \pi_{3,8} & \pi_{3,9} & \pi_{3,10} \\ \pi_{4,6} & \pi_{4,7} & \pi_{4,8} & \pi_{4,9} & \pi_{4,10} \\ \pi_{5,6} & \pi_{5,7} & \pi_{5,8} & \pi_{5,9} & \pi_{5,10} \end{vmatrix} = 0,$$

which may be conveniently written—

$$\pi\begin{pmatrix} 1, & 2, & 3, & 4, & 5 \\ 6, & 7, & 8, & 9, & 10 \end{pmatrix} = 0.$$

This is the fundamental theorem of the paper; it is shown that, if the power of a straight line and a circle be defined as the perpendicular from the centre of the circle on the straight line, and the power of two straight lines as the cosine of the angle between them, then the theorem is true if any circles of either system be replaced by points, straight lines, or the line at infinity.

The general theorem is then applied to prove some properties of special systems of circles, and more particularly those systems